

Between controversy and plebiscite: is carrying capacity useful for decision support in marine protected areas?

Recommendations resulting from a partnership approach

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1. A collective thinking process about carrying capacity

The main questions raised by researchers and MPA managers associated to GIS HomMer concern the normativity and feasibility of the carrying capacity (CC) (fig. 1), in a context characterized by growth of multi-objectives protected areas with new governance models.

Fig. 1/ Main questions about CC (survey, Sept. 2015: answers expressed in absolute value according to the profile of respondents)

1. Normativity: objectify or justify management decisions
2. Feasibility: identification of thresholds or optimums
3. Knowledge: interactions between uses and environment

Researchers	Managers
1. Normativity	1. Normativity
2. Feasibility	2. Feasibility
3. Knowledge	3. Knowledge

Survey
(14 researchers, 16 managers), Sept. 2015
Reference: Le Gentil *et al.*, 2016

National workshop
(13 researchers, 18 managers), Nov. 2015
Référence: Le Gentil *et al.*, 2016

Systematic literature review
(67 CC assessments), first half of 2017
Reference: Le Gentil, 2017

Field data collection protocols
(natural reserve: visitor counts [81], opinion surveys [246]), summer-autumn 2018
Reference: Cavalié, 2018

1. Scientific questions about CC (research, MPA management)
2. The concept of CC : meaning, advantages and disadvantages for decision-making (MPA)
- 3a. Typology of analytical frameworks used to assess the different dimensions of CC
- 3b. Qualify the visitor experience and the potential disturbance of avifauna (not reported)

2. An overview of this concept (meaning, advantages and disadvantages)

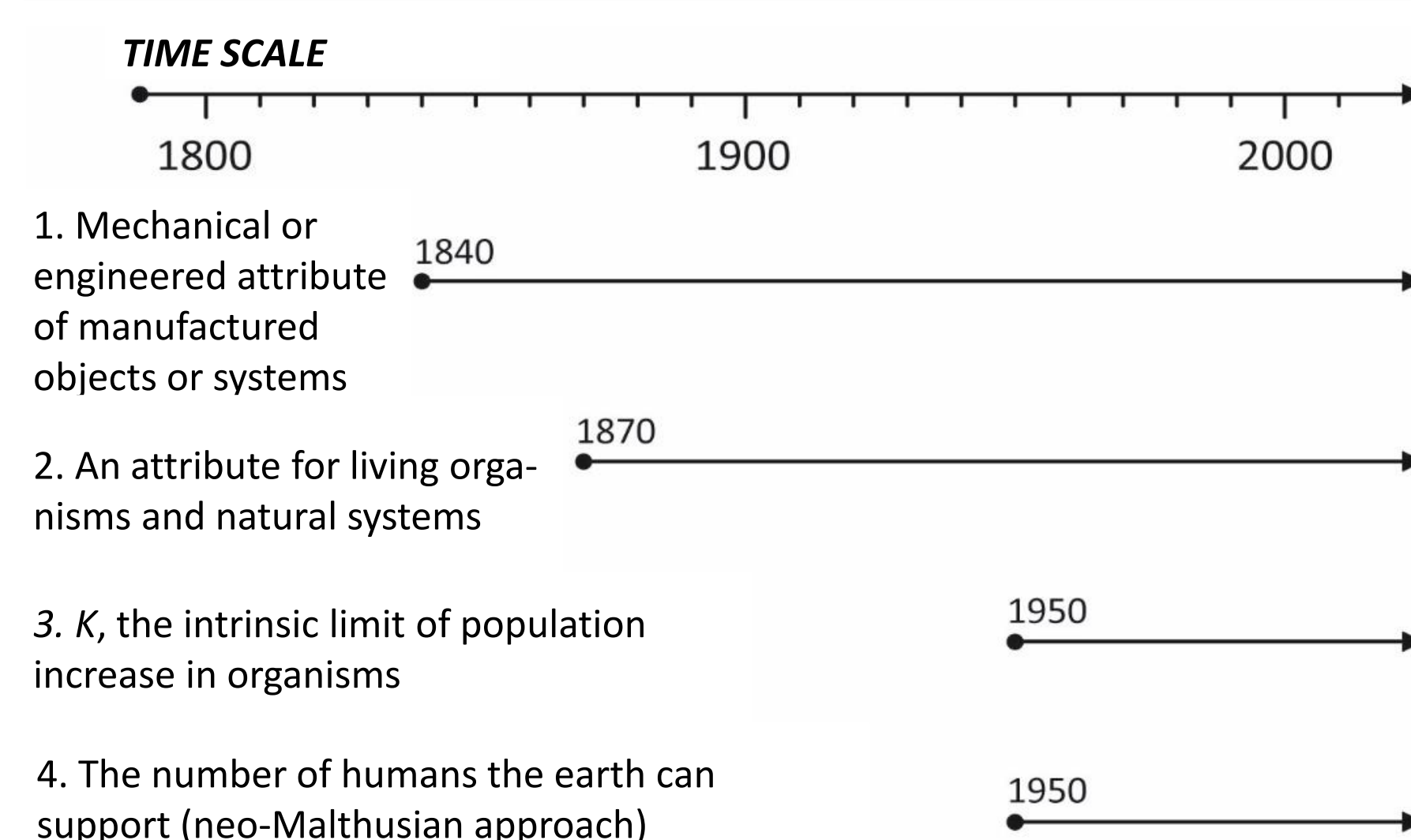


Fig. 2/ Genesis and history of CC (from Sayre, 2008)

- CC is a concept derived from engineering, taken up by a wide range of scientific disciplines (agroforestry, biology, demography, ...) (fig. 2).
- CC generally seeks to formalize the threshold effect by means of numerical value(s) beyond which one or more phenomena occur.
- There are many definitions of CC. They refer to different dimensions: physical, biological, ecological, social or economic.
- CC is a controversial concept because of its subjective and normative scope, inspired by Malthus.

Advantages	Disadvantages
<ul style="list-style-type: none"> • An integrative concept (research-management, SS-LSi) • An intuitive concept • It questions the notion of growth and its consequences • It questions nature conservation policies 	<ul style="list-style-type: none"> • Several definitions, often unclear • Normative (<i>numerus clausus</i>) • Often conceived as ideal, static, and numerical • Hard to measure (thresholds or optimums)

Tab. 2/ Advantages and disadvantages of CC (workshop, Nov. 2015)

At the request of MPA managers, members of GIS HomMer have experimented with this approach.

3. An experiment to qualify the visitor experience (Sept-Îles archipelago)

The systematic literature review highlighted four main categories of assessment (tab. 3).

ASSESS	Conservation status	Ecosystem degradation	Well being (users)	Sustainability
Analytical framework	K / Habitat CC	RPL / PRE CC	LAC / VERP	EFI / DPSIR
Benchmark referred	To reach	Not to exceed	Not to exceed	Not to exceed
Expression of results	Population size	Use levels	Use levels	Ratio pn/cn
Activities to regulate	None specific	Recreative use, tourism	Recreative use, tourism	Artificialization
Study areas	Protected areas, small to large areas	Small to large areas	Protected areas, very small areas	Very large areas

Tab. 3/ Main categories of assessment (systematic literature rev.)
Research carried out in October 2016 in the SCOPUS and ISI Web of knowledge databases (13 queries made on the "title" field for the period 2000-2015), 244 distinct peer-reviewed papers identified, 67 assessments selected according to several inclusion and exclusion criteria. Typology performed by AHC (Jaccard index).

In accordance with the management plan (Provost, 2015), and in agreement with the local stakeholders of the Sept-Îles archipelago (natural reserve: LPO, Perros-Guirec Mairie, Conservatoire du littoral, maritime carriers), the visitor experience (well-being) was studied on Île aux Moines (Cavalié, 2018), where the trail plan was modified in 2014 (Freytet, 2011).

The protocol tested (fig. 3) aimed to question the relationships between observed and perceived visitor levels, embarrassment experienced and satisfaction expressed at the end of the visit.

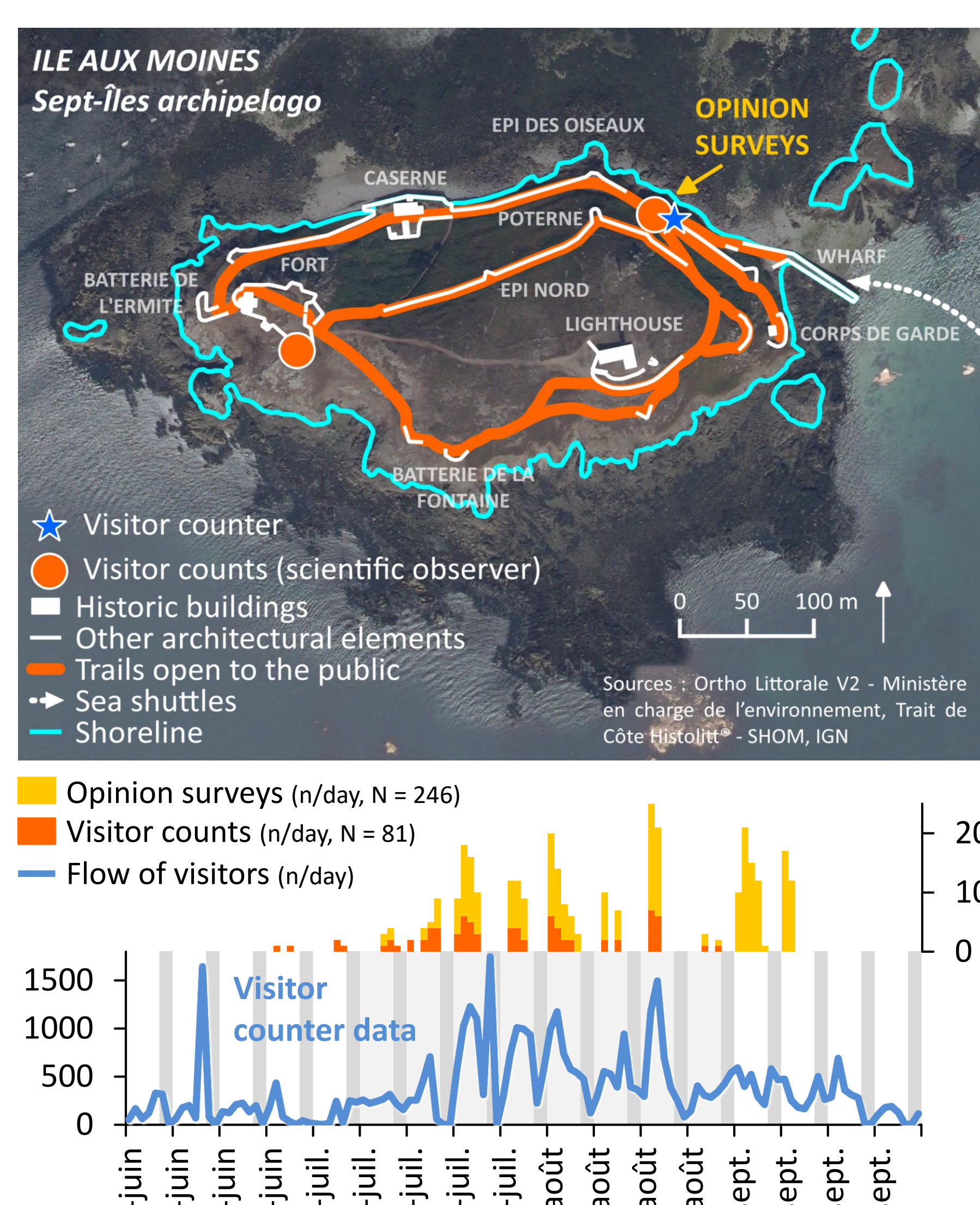


Fig. 3/ Protocol tested (June-September 2018)

The visitor experience today seems nice, whatever the level of observed visitor (fig. 4).

This reference standard can help local stakeholders in their reflection about the sustainable valorization of heritage of the Sept-Îles archipelago.

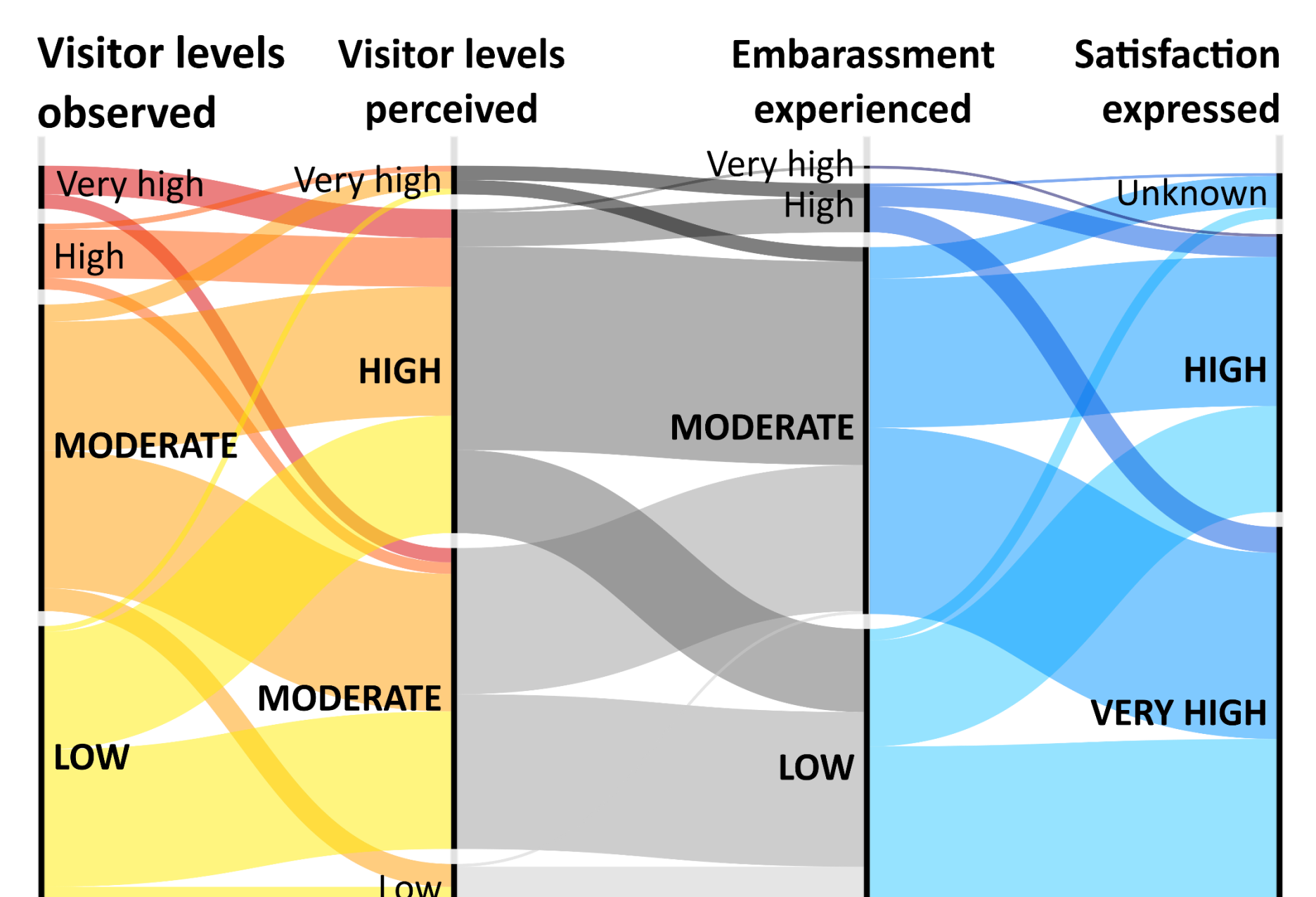


Fig. 4/ The visitor experience: no relationships between the levels of observed visitor and satisfaction expressed at the end of the visit.

RECOMMENDATIONS

1. Assess CC only for clearly identified management objectives.
2. Assess CC in small areas.
3. Assess few dimensions simultaneously.
4. Associate the local stakeholders to the CC assessment process.
5. Consider the CC in the broader context of a territorial project, defined by the stakeholders.

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